DOCUMENT RESUME

ED 062 085 RE 004 066

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TITLE Teaching Children to Discriminate Letters of the Alphabet Through Errorless Discrimination Training.
PUB DATE Apr 72
NOTE 9p.; Paper presented at the meeting of the American Educational Research Association, Chicago, Ill., Apr. 1972

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Discrimination Learning; *Error Patterns; Feedback; *Letters (Alphabet); *Preschool Children; Reading Research; *Reinforcement; Sequential Learning; *Word Recognition

ABSTRACT

Each of two experimenters taught one set of 32 prekindergarteners to discriminate four different letter combinations (R-P, Y-V, C-G, and K-X). Each set of children was randomly selected and assigned to two treatment conditions. The treatment consisted of three warm-up trials, 10 actual training trials, and four post-test trials on a match-to-sample task. The errorless discrimination training group (EDT) was not given any feedback for each trial, while the reinforcement-extinction group (RE) was told after each trial if his responses were correct or incorrect. Error numbers during training trials and criterion trials were separately analyzed. The mean number of errors was 4.06 for the EDT group and 16.89 for the RE group. None of the other main effects or interactions were significant. The mean error during the post-test trials was 2.95 for the EDT group and 6.53 for the RE group. The sequence main effect and the interactions were insignificant. However, there was a main effect for experimenter; the author felt that the difference could be accounted for by the increased number of errors made by the RE group in Set II. Table and reference are included. (AW)

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RE 004 066

Teaching Children to Discriminate Letters of the Alphabet Through Errorless Discrimination Training[1]

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The procedure typically used in laboratory discrimination learning studies involves telling the S whether his choice of the stimulus to be discriminated was correct. This procedure of reinforcement and extinction inevitably entails errors and according to Gollin and Savoy, 1968; Sidman and Stoddard, 1967; and others, is not the most efficient means of visual discrimination training. These studies have shown that by using an errorless discrimination training approach Ss learned a match-to-sample, visual discrimination task much more efficiently and quickly than by training on the final discrimination alone.

It is this same reinforcement-extinction technique that is also used in the typical classroom. Children are presented the stimuli to be discriminated on a number of trials and are given feedback by the teacher as to whether or not their response was correct. The child is given positive feedback if his response was correct, but he is often uncertain as to why the discrimination was correct. It is possible that the child could make the correct response without being aware of the salient cue that differentiates one stimulus complex from another. In the case of the incorrect response, the child is given negative feedback, presented with the same task on another occasion, and is seldom taught the distinctive features of the stimuli that must be recognized in order to make the correct discrimination. Incorrect responses indicate that the child has responded

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[1]This is an expanded version of a paper presented at the American Educational Research Association, Chicago, 1972.

to a cue that provides irrelevant information for making the correct discrimination. Allowing the child to respond to an irrelevant cue and then attempting to extinguish that incorrect response would appear to be an ineffective way of teaching children to make correct discriminations.

A necessary first step in learning to read is the discrimination of the letters of the alphabet. A child has to learn that each letter is unique and that it varies in some way from all the others in the alphabet. According to Gibson (1969), the process by which a child learns to discriminate objects and symbols is through differentiation. Differentiation theory maintains that as a result of practice the child is able to respond to more specific aspects of the impinging stimuli from his environment. Discrimination learning, then, is an increase in specificity which can be described as detection of properties, patterns, and distinctive features from an array of stimulation. (Gibson, 1969, p. 77). Once the child is able to differentiate a stimulus array by its distinctive features, he is able to discriminate that stimulus from others that are similar. Errors occurring during training indicate that the child is engaged in solving the stimulus problem by responding to an inappropriate cue, and until the child learns the distinctive characteristics which differentiate one stimulus array from another he will not be able to make the correct discrimination.

In the present study an errorless discrimination training approach was used to teach a group of culturally-deprived preschool children to discriminate certain letters of the alphabet. In errorless discrimination training the stimulus to be discriminated is presented with an obvious cue which guides the child so that he cannot avoid making the correct response. In the present study the obvious cue was used to highlight the distinctive

feature of the letter to be discriminated. Gradually as the child responds under the control of this obvious cue it is changed so that it becomes more like the stimulus which is desired as the controlling stimulus. Two groups of children were taught to discriminate certain letters of the alphabet. One group was taught using errorless discrimination training (EDT) and a second group was taught to discriminate the letters using a reinforcement-extinction (RE) approach.

Method

Selection of Subjects:

Sixty-four children were randomly selected from two prekindergarten programs which had an approximate enrollment of 100 inner city children. Each child was randomly assigned to one of the two treatment conditions. Any child below age 4 years, 3 months or above 5 years, 3 months at the time of the study was not included. None of the children were able to identify any of the letters of the alphabet prior to the training.

Training Materials:

The discrimination problem for both groups was presented in a match-to-sample format where the child was required to discriminate between two letters by selecting the letters that match the standard at the top of the card. The following four letter combinations were used: R-P, Y-V, C-G, and K-X. The criterion for selecting these four combinations was based on the work of Gibson, (1969, p. 90) who showed that each combination contains letters with a number of similar distinctive features which makes them difficult to discriminate. These letters were also selected on the basis of the case with which the distinctive feature of the letter could be highlighted and then faded.

The letters which were presented horizontally on a 3½ x 9 inch card were 80 point tempo bold print. For each group there were three warm-up trials, 10 actual training trials and four post-test trials. The same letter served as the standard and there were always six letters below the standard, three of which were the same as the standard. The position of the three correct and three incorrect letters was randomly assigned for each trial, assuring freedom from any order effect.

The three warm-up trials consisted of a match-to-sample task using geometric designs. On the first practice trial the experimenter demonstrated the procedure and on the following two trials the child was asked to match the correct design to the standard.

On the first of the 10 training trials for the errorless discrimination training group (EDT) the relevant cue of the letter to be discriminated was highlighted in bright red. For example, the stem of the R in the R-P discrimination was highlighted in red. On subsequent trials the highlighted cue was gradually faded. On the tenth trial the highlighted cue was black, the same color as the rest of the letter. The children in the EDT group were not given any feedback after each of the ten training trials or the four post-test trials.

The children in the reinforcement-extinction group (RE) were given ten training trials using all black letters. After each trial the S was told if his responses were correct or incorrect. The RE-group was given the same four post-test trials as the EDT-group.

Procedure

Each S was trained to discriminate two different letter combinations which were presented in counter-balanced order. Thirty-two Ss were randomly assigned to either the EDT or RE-group and were taught to

discriminate two different letter combinations. A second group of 32 Ss were assigned in the same way to either the EDT or RE-groups and were taught to discriminate between two different pairs of letters. These two sets or blocks amount to a replication of the original study using different pairs of letters. Each block of 32 Ss was taught by a different examiner. The two Es were female graduate students in psychology. The analysis of the number of errors made during training and on the post-test for each pair of letters within each block was treated as a repeated measures ANOVA. Thus there were four pairs of letters which were divided into two blocks with 32 children in each block.

Results

Separate analyses were done on the number of errors during the ten training trials and the four criterion trials. The mean number of errors during training and on the post-test by experimenter, letter and training group are presented in Table 1. It should be pointed out that for experimenter I, the C-G combination was presented first for half the Ss and Y-V was first for the other half. The analysis included sequence but in order to make Table 1 easier to read the means are presented by letter.

Table 1

Mean Number of Errors

	Set I, N = 32				Set II, N = 32			
	Letters C-G		Letters Y-V		Letters R-P		Letters K-X	
	Training	Post-test	Training	Post-test	Training	Post-test	Training	Post-test
EDT-Group	4.18	1.94	4.62	3.18	4.13	2.81	3.31	3.88
RE-Group	13.06	4.75	15.19	5.75	18.63	7.13	20.69	8.50

The ANOVA on the mean number of errors made during training showed that there was a highly significant difference between the EDT and RE-groups. Combining the four letters across the two experimenters the mean number of errors was 4.06 for the EDT-group and 16.89 for the RE-group ($F = 51.61$, $df = 1,56$, $p < .001$). None of the other main effects or interactions were significant (experimenter, $F = 1.80$, $df = 1,56$, ns; sequence, $F = 3.03$, $df = 1,56$, ns). Sequence within experimenter was nonsignificant ($F = .33$, $df = 2,56$) and the interaction of treatment X sequence within experimenter was nonsignificant ($F = .84$, $df = 2.56,$). Thus, as might be expected, the only significant result during training was the fewer errors made by the EDT-group as compared to the RE-group.

The mean number of errors during the post-test trials across the four letters for the EDT-group was 2.95, which is significantly less than the mean of 6.53 for the RE-group ($F = 19.99$, $df = 1,56$, $p < .001$). The sequence main effect was not significant ($F = .32$, $df = 1,56$, ns) and none of the interactions approached significance. There was a main effect for experimenter. The mean number of errors for both treatment groups for Set I and II were 3.91 and 5.58, respectively. ($F = 4.36$, $df = 1,56$, $p < .05$). After looking at the data it appears that the experimenter difference can be accounted for by the increased number of errors made by the RE-group in Set II. However, these differences in post-test means between Set I and II were not statistically analyzed since none of the interactions were significant. It is impossible to tell if the differences between Set I and II were due to actual examiner differences or to the possibility that the letter combinations R-P and K-X are more difficult to discriminate than the combinations C-G and X-Y.

In summary, the analysis indicated that children who were taught to discriminate between pairs of letters using an errorless training technique made fewer errors on the post-test as compared to a similar group taught using a reinforcement-extinction approach .

Discussion

The results of the present study give strong support for the use of errorless discrimination training in teaching young children to discriminate letters of the alphabet. The children who were taught to discriminate letters by errorless training, which consisted of highlighting the distinctive feature of the letter in red and then fading this obvious cue, made significantly fewer errors during training and on the post-test as compared to children taught using a reinforcement-extinction approach. These results have theoretical importance as well as having tremendous educational potential for the early stages of learning how to read.

Theoretically the results indicate that it is not necessary for the child to make errors in the process of learning the distinctive features of difficult to discriminate stimuli. The argument that the child must make a number of errors in order to eliminate responding to the irrelevant cues of the discriminative stimulus is not valid according to the results of the present study. It was obvious for many of the children in the RE-group that when they made the correct choice they did not know why it was correct and when they selected the wrong letter they had difficulty understanding why it was wrong. It appeared that many of the children in the RE-group would have considerable difficulty learning the distinctive feature that differentiates the two letters just on the basis of experimenter feedback.

When an additional obvious cue was provided as was the case for the EDT-group, there was no problem in getting the children to focus on the distinctive feature of the discriminitive stimulus. For the children in the EDT-group stimulus control was easily transferred from the highlighted color cue to the distinctive feature of the letter to be discriminated.

Errorless training has tremendous possibilities for the early stages of learning how to read. Many of the problems that children have in discriminating among letters and words could possibly be eliminated through the use of errorless discrimination training.

If the errors could be eliminated from classroom discrimination learning, it would appear that children would learn more efficiently and, most importantly, experience much less failure and frustration in the learning process. Failure and frustration in the crucial process of learning how to read, for example, produces cumulative learning deficits which result in an increasing aversion to the educational setting in general. As these children get older, they fall further and further behind academically, making any attempt at remediation more difficult. Intervention at the preschool and kindergarten level with the application of errorless training techniques offers a promising solution to this problem by providing a new approach to learning the basic discriminations that are necessary in the process of learning to read.

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